Utilising Nearpod to promote active learning in lectures.

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Abstract

Active and collaborative learning provide distinct advantages for students in higher education yet can often be hampered by the barrier of large class sizes. Solutions that combine a “bring your own device culture” (BOYD) with cloud based technologies may facilitate moving the traditional lecture from a didactic format to a discursive and interactive learning experience. In this study we describe the use of one such tool, Nearpod, to enhance interactivity in lectures delivered to pharmacy and bioscience students at Ulster University. In the latter the potential class size was in excess of 120. Existing lecture material in PowerPoint or Keynote format may be uploaded to the instructor area of Nearpod, interactive elements are added, and the lecture then broadcast via the internet to student devices. This approach provides students with instant feedback on learning. The results of each poll activity may be shared by the tutor to the group to prompt discussion. Exemplar responses from the drawing tool or open-ended questions may also be shared. Students commented favourably on the use of Nearpod in their studies especially to promote engagement with the subject matter being delivered and enhance interactivity. A majority of students were happy to use their own electronic devices (smartphones, tablet and laptops) for such activities with a minority expressing concern over problems with connecting to the institutional Wi-Fi. For the learning of chemistry and other STEM-related subjects, Nearpod and similar products represent a new class of feature-rich audience response systems that have potential to transform learning though an active and collaborative approach.

Keywords; Nearpod, interactivity, active learning

Introduction

Bonwell and Eison (1991) provide a working definition of active learning as being anything that "*involves students in doing things and thinking about the things they are doing*". In this approach introducing appropriate learning activities into lectures can improve recall of information with further benefits apparent such as successful student engagement (Prince, 2004). The challenge of promoting active learning can often be stifled by the physical spaces assigned to learning activities especially when there are large class sizes. Dugdale concludes that campuses need a “participatory architecture” to support communities of learning, harnessing the power of “existing physical place and the emerging virtual space” (Dugdale, 2009).

In tiered lecture theatres opportunities for group work and collaborative learning are limited, yet this setting is where a large number of learning activities still take place throughout the higher education sector. Practitioners have examined how best to infuse interactivity into lectures for a number of years with examples cited including student presentations and projects, in class discussion, instructional models and audience response systems (Allen & Tanner, 2005).

Significant opportunity now exists to utilise technology in the classroom in a blended approach to active learning. Technologies such as the audience response system Turning Point have been successfully employed in engaging students and have been proven effective in increasing student motivation (Cain, Black, & Rohr, 2009). One study has shown that such audience response systems increased discussion among students and helped them to determine their level of understanding compared to their peers (Efstathiou & Bailey, 2012). In the teaching of chemistry audience response systems have been used to create a positive learning environment (Vital, 2012) and to facilitate students in large classes identifying points of confusion in the lecture they had received (King, 2011). For the teaching of stoichiometry an audience response approach allowed the lecturer to correct common misconceptions noted in the answers supplied by students. The tutor concluded that the approach had helped to build student self-confidence in a topic area that many find conceptually difficult (Cotes & Cotuá, 2014).

While the examples above provide assurance that audience response systems are effective, there are limitations. In most of the cases cited above the student is limited to providing a response to a multiple choice question or a Likert scale. Shea (2016) has recently reported on new generation, cloud based response systems, which offer additional opportunities for active learning, particularly in the discipline of organic chemistry. Such tools offer additional functionality beyond the multiple choice question format afforded by the traditional voting handset. One tool, uRespond, has been developed specifically for chemistry teaching activities and may be used interactively for exercises such as graph drawing (Bryfczynski et al., 2014). A variety of such tools for learning now exist in the form of apps that may be downloaded to student-owned smartphones and tablet devices and some of these have been described previously (Donnelly, Diaz, & Hernandez, 2016; Schaller, Graham, Johnson, Jones, & McIntee, 2015; Wijtmans, van Rens, & van Muijlwijk-Koezen, 2014). Such technologies exploit the virtual learning space and in turn may also bring transformative change to the physical learning space, facilitating the participatory architecture alluded to by Dugdale (2009)

In this report we describe the use of Nearpod (Dyer & Hunt, 2015) a web based technology which makes the traditional lecture much more interactive (Moore, 2016) and extends beyond the functionality of the traditional audience response handset.

In practice, an existing PowerPoint or Keynote presentation is uploaded to the administrator area of Nearpod and interactive elements such as multiple choice questions or polls may be added. The tutor then “broadcasts” the lecture to student-owned smart devices within the class which have the free Nearpod app installed. Alternatively, lectures may be followed using the native web browser on the device. Students gain access to the lecture by input of a unique PIN code provided at the start of the session. As the lecturer advances through the presentation (shown via a projector in the lecture theatre but delivered through the Nearpod website) the slides automatically advance on the students’ devices. Interactivity elements placed throughout the presentation allow students and staff alike to gauge the level of learning achieved using polls, quizzes and drawing functions.

On some Nearpod licences, students may also take their own notes on the presentation as it advances; at the end of the session, a PDF document can be emailed to the student capturing the notes that have been made.

Nearpod also provides a facility for material to be revisited after the session in “student paced” mode so that students can work through material in their own time.

The main evaluative question of the project was:

Does Nearpod enhance student engagement and promote active learning in traditional lecture scenarios?

Study Design

The theoretical underpinning of the study followed a model of active learning (Bonwell & Eison, 1991; Prince, 2004). The focus was providing core lectures in mass spectrometry theory and practice to undergraduate bioscience and pharmacy students in a manner that would increase student engagement.

Background and Enrolment

We implemented Nearpod in a second year undergraduate module PHA302 Pharmaceutical Analysis in the School of Pharmacy at Ulster University. The study took place in the 2015/16 academic year with 35 students enrolled. As the module is also delivered to students from other courses, the potential in-class attendance was 42. Specifically, the tool was used to deliver lectures on the topic of “Mass Spectrometry in Pharmaceutical Quality Control”.

Nearpod was also used to deliver lectures on “Proteomic Mass Spectrometry” to undergraduate year one students in the School of Biomedical Sciences at Ulster University on BMS101 Bioanalysis for Nutrition and BMS106 Bioanalytical Chemistry modules. The total enrolment here was 125.

Tutor Preparation

An instructor account was registered at www.Nearpod.com and the initial free account which permits access for up to 30 students upgraded to the Gold account permitting 50 concurrent logins. Varying levels of Nearpod functionality exist depending on the licence purchased. Lecture material in PowerPoint format was uploaded to the Nearpod site and interactivity elements such as multiple choice questions, polls and “draw it” elements added using the online dashboard. In the “Draw It” activity students could draw directly using the palette provided. Alternatively, the sketch could be drawn freehand on paper, a picture taken using the camera on the device and then uploaded. A final alternative is to search for an image on Google images, if the lecturer deems this appropriate. Figure 1 shows an example student-facing screen for the “Draw it” activity. In this case the structure of an organic acid was expected as the response.

Other “Draw It” activities included the following:

- Draw a schematic representation on a MALDI-ToF mass spectrometer
- How many electrodes does an ion trap have? Draw a basic configuration of an ion trap mass analyser
- Draw a Lissajous figure

When the tutor receives images from students selected examples may then be shared with the rest of the class directly to their screens. Following the session the lecturer may review all of the student responses using the reporting function in Nearpod. An example screenshot is provided in Figure 2.

Student Preparation

When planning a Nearpod activity some consideration needs to be given to the lecture location and the availability of WiFi. This is of particular relevance if the session is to be delivered to large numbers of students.

Students were informed in advance that the lectures would be delivered using Nearpod and told to bring their own devices to class such as smartphones, tablets or laptops. They were asked to download the free Nearpod app as this would enhance their experience of using the tool. For the BMS101/BMS106 activity the number of students attending exceeded the number of available logins. In this scenario students were asked to share devices in small groups of two or three. This was sufficient to promote discussion of questions relevant to the material and to enhance active learning.

Delivering the Session

At the start of the lecture the tutor logs in to the Nearpod site via an internet browser and creates a live session. This generates a unique PIN code which is communicated to all students in the group. They can then use this to participate in the session. Students must provide a username to access the lesson; this information is available to the instructor. In our implementation of Nearpod we have found it helpful for the tutor to project the student-facing view of the lecture on screen so that if students encounter difficulty accessing the presentation on their devices they are not disadvantaged. While this counts as an additional login it is deemed useful for the activity.

Once the session commences the lecture is broadcast to students' screens and they follow the lecture as it proceeds. The lecturer may choose to deliver the session using a tablet device allowing them the advantage of moving freely around the room.

As interactive elements such as polls or quizzes are presented to students they have opportunity to discuss these with peers and then select their answer. The instructor may then share the responses to the group which for polls and quizzes is presented as a pie chart of responses.

For other elements such as open ended questions or drawing activities, the instructor can monitor responses as they are submitted in real time in a gallery interface. Exemplar responses may be shared with the entire group to prompt further discussion. This is particularly useful if students are asked to provide a structure for a particular compound; and further to this aids in the learning of nomenclature in organic chemistry.

Post Session

Following the teaching session the instructor may access detailed reports of all student interactions during the session and choose to receive this by email as a PDF document.

For students wishing to access materials after class, this may be facilitated using a “student paced” session where students are provided with a separate PIN number and then can access the material in their own time.

Evaluation

Implementation of Nearpod was centred upon student self-evaluation of uptake and usage and whether the tool provided a more active approach to learning than a traditional didactic learning experience. Barriers to engagement were examined such as student-owned technology, sharing of devices and available WiFi.

Following their respective lecture sessions, students were provided with questionnaires that explored their experience of using Nearpod and gave an opportunity for them to detail any problems encountered. There was a mix of qualitative and quantitative questions measured using Likert-scale responses. A copy of the questionnaire is provided as supplementary information.

All students who participated in the lectures were invited to attend a focus group where further qualitative information about their experience could be collected. Responses were recorded anonymously and transcribed by a researcher not directly involved in the delivery of lectures.

Ethics

The project was reviewed by Ulster University School of Biomedical Sciences Ethics Filter Committee, project number FCBMS-15-072 and permitted to proceed. All students were provided with participant information sheets for the questionnaire and focus group data collection sessions. Students were informed that their participation was voluntary and that they could withdraw at any time.

Evaluation Results

Questionnaire Data

A total of 63 questionnaires fully completed with Likert-type data were returned and analysed from the two cohorts of students; PHA302 (n=33) and BMS101/BMS106 (n=30). Of the 63 respondents 24 said that they had previously used a technology similar to Nearpod in lectures. The majority of students (37) accessed the lectures via the Nearpod app while 19 used the internet browser on their device; two students used both modes. A total of five students shared a colleague's device to participate in the lectures.

All students agreed that Nearpod was an easy tool to learn to use, and 61 students would like to use it again. Seven students said they encountered technical difficulties when using Nearpod on their device.

Figure 1 provides an overview of the responses provided in relation to the learning gains and interactivity opportunities provided by Nearpod. This indicates that students see Nearpod as promoting engagement, improving understanding of materials and enhancing discussion between students. Figure 2 reports on student satisfaction with the use of Nearpod. This is again is positive with only a few students reporting dissatisfaction with aspects such as connecting to the institutional Wi-Fi network.

Qualitative free response comments received in the questionnaires corroborate the interactive nature of Nearpod and some of the technical aspects that proved difficult. Representative responses are presented in Table 1.

<u>Focus Group Data.</u>

All students who participated in the evaluation were invited to attend a focus group. Six students attended, (two male and four female) all from the year one BMS101/BMS106 cohort.

The discussion was designed to gather information from the students in regard to the following outcomes:

1. The general impression of using Nearpod in class.
2. Technical issues when using Nearpod.
3. The use of the students own device in class for activities such as Nearpod
4. The sharing of their own device with others sitting nearby in the lecture theatre
5. The ability of Nearpod to make lectures more engaging
6. How Nearpod compares to traditional lecture formats
7. The main advantages of using Nearpod
8. The disadvantages of using Nearpod
9. How lectures with Nearpod could be improved for the future
10. The continued use of Nearpod
11. Other comments regarding Nearpod

Outcome 1: Students were asked "What was your general impression of using Nearpod in class?"

All students described their general impression of Nearpod as being positive. They used various phrases to describe their experience including, "*I enjoyed it because it's interactive*", "*the interactive questions were relevant to the content we recently covered and helped to reinforce our understanding of the topic*" "*it tests your knowledge of the subject and if I don't know the answer to a particular question I then know that I need to focus on that area when revising*", "*it makes you take part rather than sitting back during lectures*".

Outcome 2: Students were asked "Did you encounter any technical issues when using Nearpod?"

All students agreed that the only technical issue was the limited amount of logins available. Fifty students were able to log in whilst the remainder of the class shared with those able to log in.

One student suggested that the drawing tool could be more user friendly, whilst the remaining 5 students were pleased with it in its current form.

Outcome 3: Students were asked "Are you happy to use your own device in class for activities such as Nearpod?"

All of the students were happy to use their own device during class. Another student pointed out that they had a device that was unable to connect to the University's Wi-Fi. This issue was rectified, however the student was concerned that there may be others that do not have the capability to connect to the Wi-Fi.

Outcome 4: Students were asked "If you didn't have your own device would you be happy to share with others sitting nearby in the lecture theatre?"

Five students were happy to share their device with other students during lectures, and described it as being another way to build cohesion and get to know classmates. One student said they wouldn't mind sharing with someone they knew but were concerned that previews of personal messages may be viewed on their device.

Outcome 5: Students were asked "Did you think that Nearpod makes lectures more engaging?" All six students said that Nearpod made lectures more engaging.

Outcome 6: Students were asked "Do you think that you learned more about the topic when presented using Nearpod than if a traditional lecture format had been used?"

All of the students stated that they believed they learned more when using Nearpod than the traditional lecture format. Nearpod was described as being “more engaging” and that it “kept my attention better than usual lectures”. Nearpod aided one student in recalling details about the topic whilst ordinarily they would have to revisit their lecture notes several times. Another student agreed and stated that “because [I am] involved in the class a lot more than normal I take more notes”

Outcome 7: Students were asked “What do you think are the main advantages of using Nearpod?

The main advantages of Nearpod were listed as being; “*the interaction*, *it’s good for feedback*, *if you answer the question wrong you still learn from it*, *if someone has an issue with some of the content, the lecturer can add to the slides by drawing structures*.

Outcome 8: Are there any disadvantages of using Nearpod?

Two students reiterated the lack of access for all of the class whilst the remaining four students couldn’t think of any disadvantages

Outcome 9: Students were asked “How might lectures with Nearpod be improved for the future?”

Students would like to see Nearpod available to every student. One student said that they would like to receive the lecture notes after the class, including the questions and answers that has been posed during the lesson. It was questioned whether the tool could be used remotely. One student said that in an ideal world they would be given a device to use Nearpod on such as a tablet.

Outcome 10: Students were asked “Would you like to see Nearpod used again in your studies?”

All students would like to see Nearpod used again in their studies. Three students would like to see Nearpod used in other modules as well, particularly those involving complex [biochemical] pathways.

Outcome 11: Students were asked “Are there any other comments you would like to make about using Nearpod in class?”

Two students repeated their belief that Nearpod enhanced the lectures by engaging them, the remaining students made no further comments.

Discussion

In our hands Nearpod has proved to be a valuable tool to increase interactivity in the classroom when delivering mass spectrometry lectures. We plan to further extend its use in the future, particularly in large classes where stimulating engagement and promoting active learning can be a challenge.

Implementing interactive tools such as Nearpod impinges on other key operating concerns such as licensing, Wi-Fi connectivity and inculcating a “bring your own device” (BYOD) culture in higher education. Thomson argues that while there are obvious security concerns, the move to BYOD in future enterprise scenarios is inevitable. IT and security departments therefore have a key role in “managing the chaos” of BYOD rather than being barriers to positive transformation (Thomson, 2012). The same challenge exists in higher education, and while there have been pockets of good practice with BYOD initiatives, more rigorous pedagogic frameworks need to be developed to maximise benefits to the full (Cochrane, T., Antonczak, L., Keegan, H., Narayan,V., 2014). In our scenario there were no major issues with students using their own devices though a small number did encounter problems accessing the WiFi. It is clear that the ideal scenario exists when students have their own device and an individual login to Nearpod. This is something we will explore in the future. While sharing of devices may increase interactivity and discussion within the class it is important that student privacy is not breached by previews of personal messages being shown to those sharing the device.

A concern for most learning practitioners is the extent to which students are actually engaging in course material during lectures. While technology can be useful in engaging students, there is also the danger that it may provide an unwanted distraction. However, Barry et al (Barry, Murphy, & Drew, 2015) have shown that careful design of learning activities to include mobile technologies can assist in constructive alignment with learning outcomes and thereby enhance the student experience. Using tools such as Nearpod increases the type of interactive activities that can be used especially in large classes. By providing a free response question students may also type specific queries or concerns they have about material; ask questions anonymously or provide comments.

Our project as described here represents a viable and scalable means of utilising technology to enhance interactivity in lectures. Of particular relevance to science educators is the drawing tool which allows students to submit sketches of structures, representations of equipment or even mathematical calculations or equations. It may also be possible to sketch a graphical representation of data and then submit these to the instructor who can readily share examples with the class. The tool may also help advance learning in organic chemistry where students sometimes find difficulty in learning nomenclature of compounds (Everett, 2014)

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Table 1 Free response comments from students in questionnaires

Positive aspects of using Nearpod in class	• *Allows more interaction with the lecture material* • *I engaged better in the class* • *Very interactive, encourages you to pay attention and engage.* • *Interactive and can see notes up close.* • *Simplicity and convenience of presentation on phone.* • *Easy to use and fun way of learning.* • *Very engaging, helped me to really grasp what we were studying by doing questions at the end.*
Aspects of using Nearpod in class that could be improved upon	• *If you are using a phone device and have to share it can be quite small.* • *The amount of people being able to be connected at one time.* • *The ability to look back at previous slides.* • *It seemed unnecessary – most of what was done could have been done on paper or using the TurningPoint handset.* • *If we were able to take it home to use; this was changed so we could… which worked brilliantly.* • *PowerPoint lectures on BBLearn are still better for revision, however this is still good for involvement in a lecture.* • *Being able to edit notes, for extra material mentioned in lecture.*

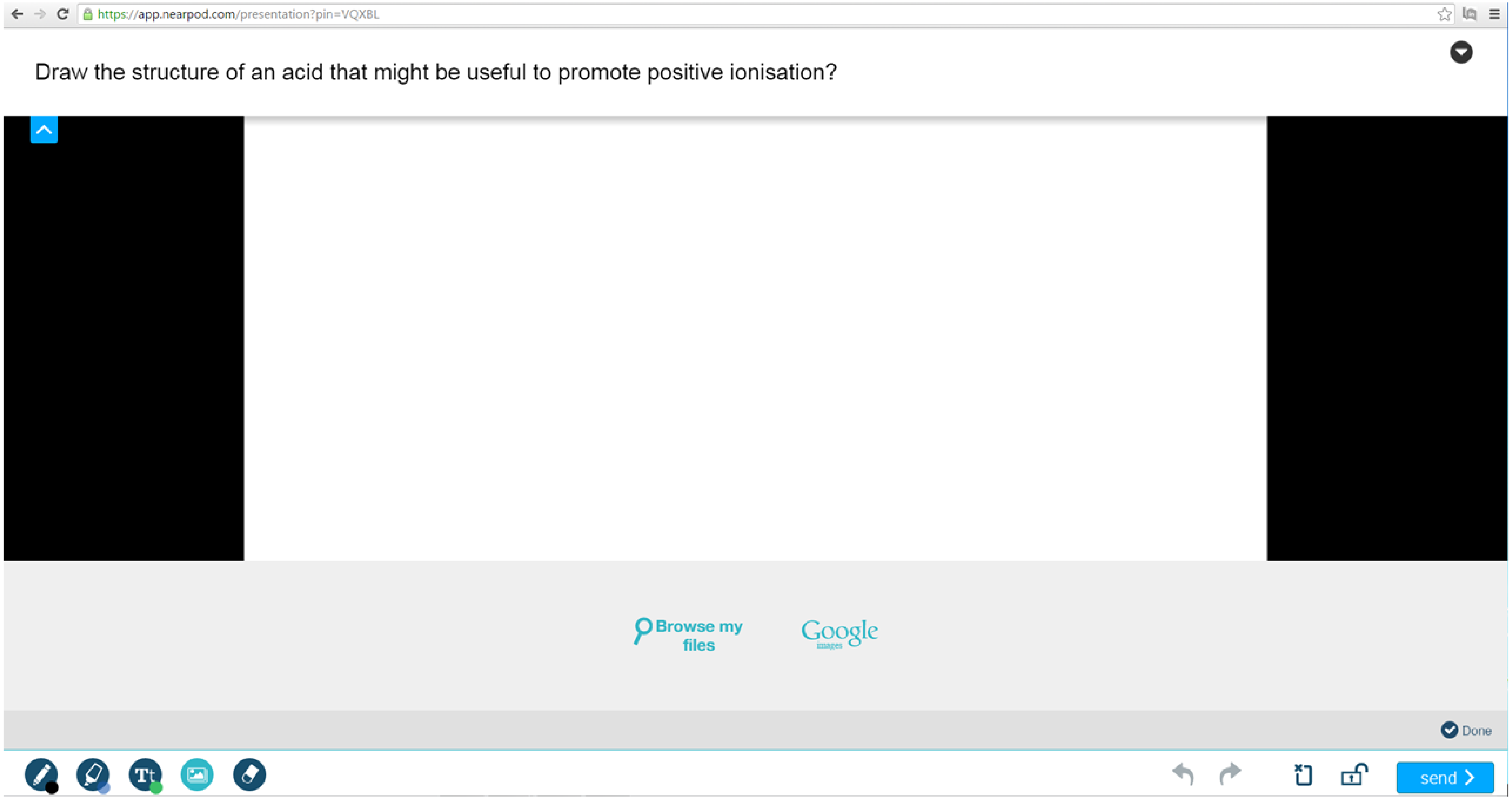

Figure 1: Example "Draw it" activity on Nearpod where students can submit a sketch to the lecturer using the draw function, browsing files on their device or searching Google images.

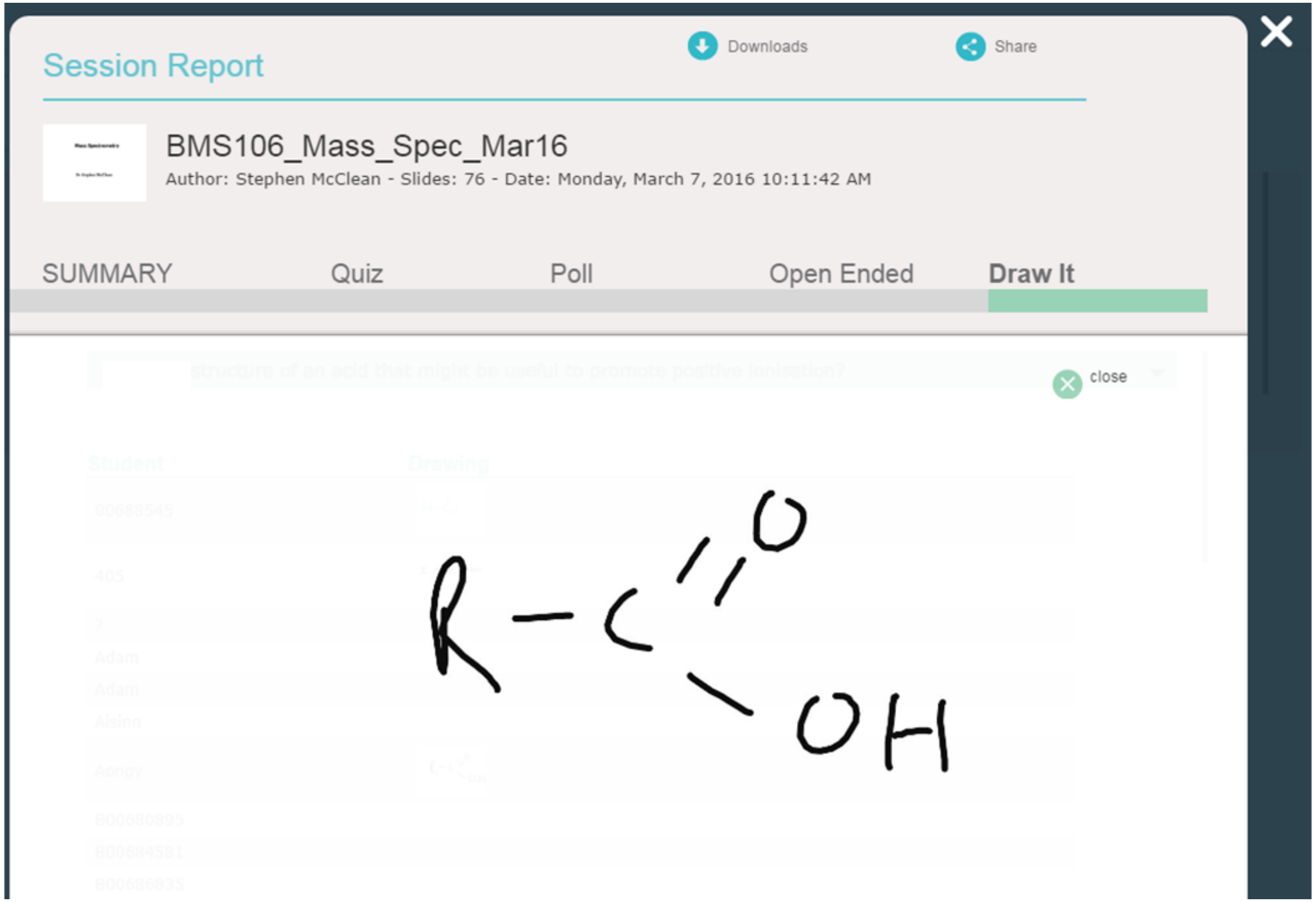

Figure 2: One aspect of the “Session Report” that can be browsed by the tutor after the session. Individual responses may be reviewed as per the screenshot above.

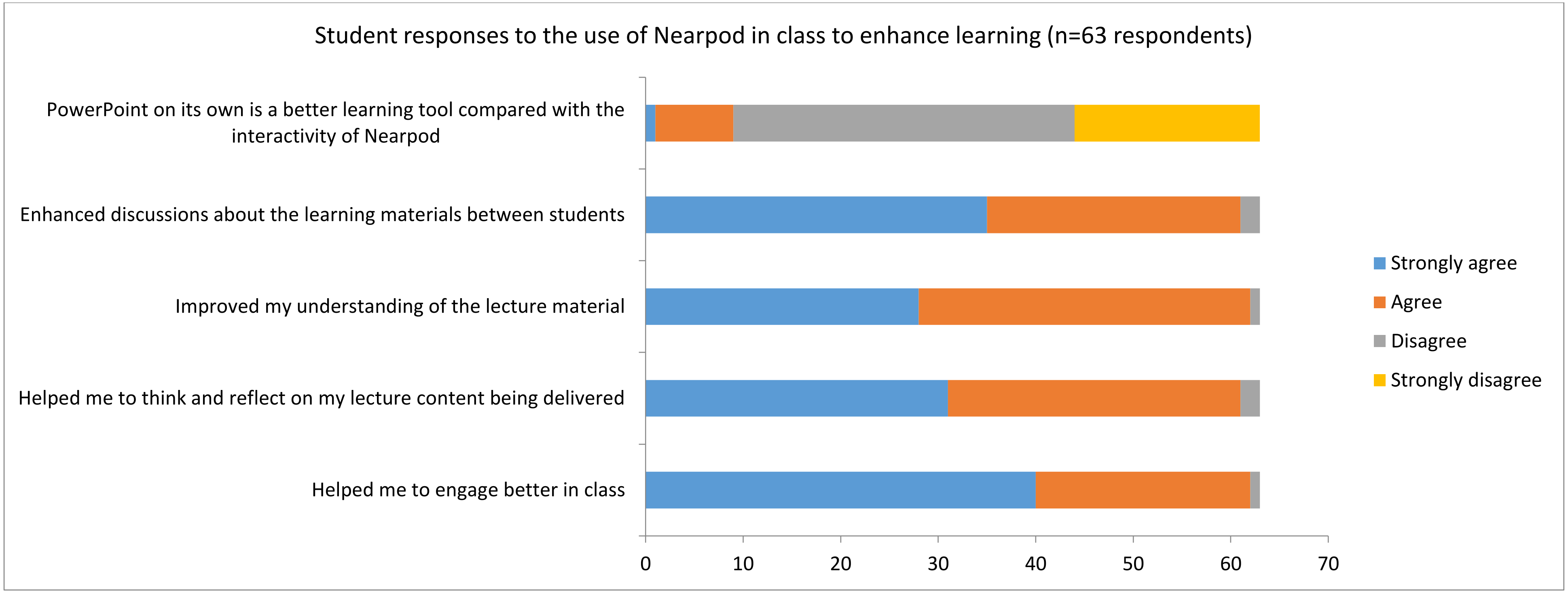

Figure 3: Student responses to the use of Nearpod in class to enhance learning; n = 63 respondents.

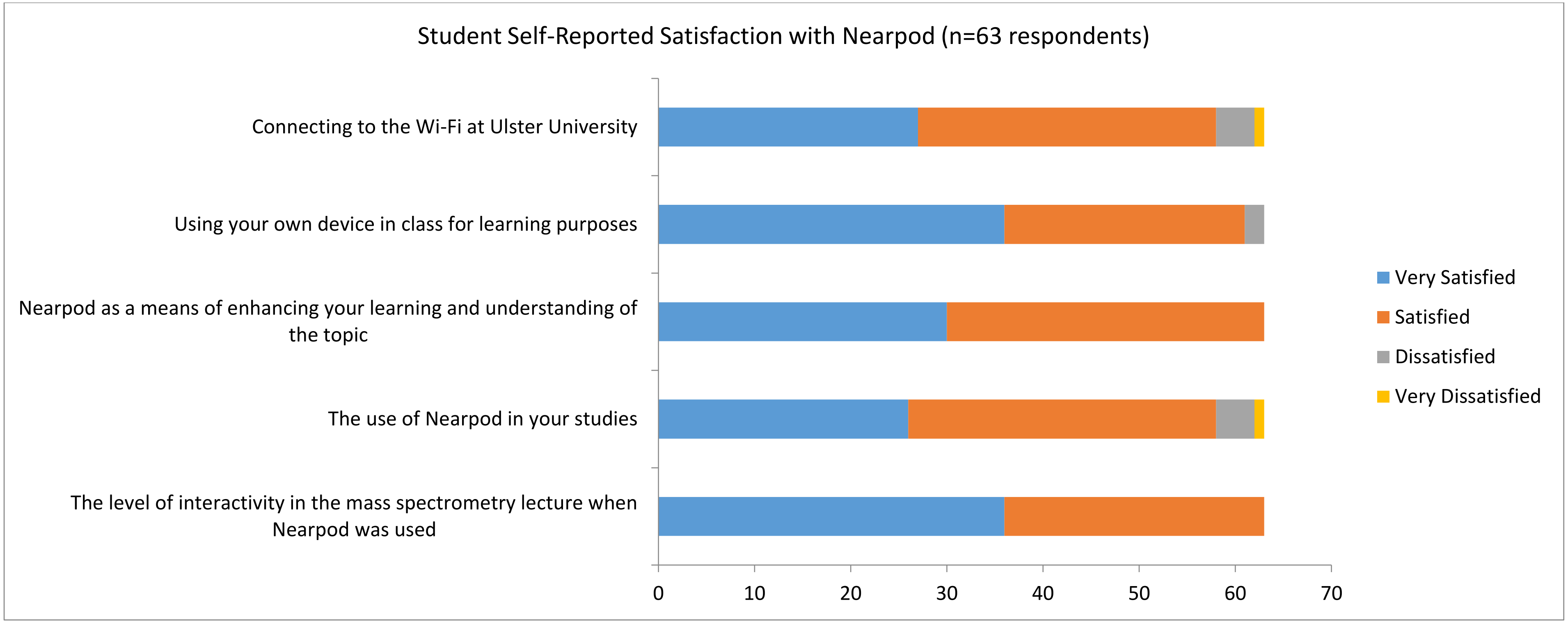

Figure 3: Student self-reported satisfaction with Nearpod; n = 63 respondents.